

SUMMARY OF THE INVENTION

According to one embodiment of the present invention, a sequential read-out method and system for reading out an array of photocells are described. The array includes a plurality of photocells that are arranged in rows and columns. A sequential readout circuit is provided for reading out the values of each photocell in a sequential fashion. The sequential readout circuit processes one photocell at a time and can, for example, determine a difference between a final integration light value and a reset value for each photocell in a time sequential manner. The sequential readout circuit can include a sample circuit for each column of photocells for sampling the output of the photocells of the respective column. The sequential readout circuit can include a single charge conversion circuit (e.g., an amplifier) for reading out the sampled value of the respective sample circuit in a time sequential manner. The sequential readout circuit also can include a column switch for each column that selectively connects the sample circuit of the respective column to the charge conversion circuit.

According to one embodiment of the present invention, a method of sampling an array of photocells is provided. First, the photocells of a current row are sampled. The sampled values are then held by a respective sample and hold circuit (e.g., one sample and hold circuit per column). Next, the photocells of the current row are reset. Then, each photocell in the current row is processed one photocell at a time. For example, the difference between a first voltage level and a second voltage level of each photocell in the current row may be determined and read-out in a time sequential manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements.

5 FIG. 1 is a block diagram of a system according to one embodiment of the present invention that includes an array of photocells and a sequential readout circuit.

FIG. 2 is schematic diagram illustrating in greater detail the system of FIG. 1 according to one embodiment of the present invention.

10 FIG. 3 illustrates in greater detail an exemplary photo cell architecture that can be utilized in FIG. 1 according to one embodiment of the present invention.

FIG. 4 is a flowchart illustrating the steps performed by the sequential readout circuit of FIG. 1.

FIG. 5 illustrates a timing diagram showing selected signals of FIG. 1.

FIG. 6 illustrates a prior art photocell architecture.

15 FIG. 7 is a diagram that illustrates exemplary circuits that may be added to FIG. 2 for gain manipulation and level shifting

DETAILED DESCRIPTION

A sequential read-out method and system that employs a single amplifier for at least two photocells that are disposed in different columns are described. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the present invention.

System 10

FIG. 1 is a block diagram of a system 10 according to one embodiment of the present invention that includes an array of photocells and a sequential readout circuit. The system 10 includes an array 14 of photocells 18. For example, the photo cells 18 can be arranged in M rows (i.e., row_1, row_2, .. row_M) and N columns ((i.e., column_1, column_2, .. column_N). Each column typically includes a current source 19 (e.g., column source_1, column source_2, ..., column source_N) for providing bias to the output buffers in the photo cells attached to the column. The construction and operation of current sources are well known by those of ordinary skill in the art and shall not be described in greater detail herein.

The number of rows and columns in the array of photocells varies based on the resolution requirements of the specific application. For example, in an optical mouse application, a sixteen by sixteen array of photocells is typically employed. Scanning applications typically include an array of forty-eight by forty-eight photocells. For these applications, each photocell can have dimensions, for example, in the range of about 30 to 60 microns on each side.

The system 10 includes a sequential read-out circuit 20 that is coupled to the array 14. The sequential read-out circuit 20 includes a plurality of sample circuits 24, where there is one sample circuit for each column. The sample circuits 24 can be implemented as a capacitor as described in greater detail in FIG. 2.